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U.S. PATENT APPLICATION

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Invention: METHOD FOR, AND THE CONSTRUCTION OF, A LONG-DISTANCE
WELL FOR THE PRODUCTION, TRANSPORT, STORAGE AND
EXPLOITATION OF MINERAL LAYERS AND FLUIDS

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SPECIFICATION

METHOD FOR, AND THE CONSTRUCTION OF, A LONG-DISTANCE WELL FOR THE PRODUCTION, TRANSPORT, STORAGE AND EXPLOITATION OF MINERAL LAYERS AND FLUIDS

FIELD OF THE INVENTION

5 The present invention relates to a method for the construction of an arrangement for Extended Reach Wells (ERW) for the production, transport, and exploitation of mineral layers, a well arrangement constructed in this manner, and a method for the construction of a network of ducts for the transport and storage of fluids. More specifically, the present invention relates to a method for
10 the production of oil and gas, a method for the transport and storage of the oil and gas thus produced, a method for the drilling of long-distance petroleum and gas wells, and a method for the exploitation of reservoirs of petroleum and gas.

 The present invention relates to a method of drilling and exploitation, production, transport and storage which includes the initial drilling of a well of
15 medium distance and at least one multilateral well of medium distance in the initial direction of drilling, and in at least one direction of the reserve which it is intended to use for production. The method allows for very distant areas of the reserve to be reached, this being achieved with the aid of conventional technologies and at low cost. The method is applied principally in extremely
20 deep water as well as in land areas with difficult access.

BACKGROUND TO THE INVENTION

 Long-distance wells have long been used extensively in industry. In the past few years these wells have become viable for the exploitation of fields, extending the service lives of some and increasing the reserves available.
25 Nevertheless, the applications of long-distance wells are limited by prohibitive costs resulting from the specifications for the drilling probes and other problems of a technical nature, as well as the precarious remote control, excessive torque

and pull, difficult cleaning from the well hole in long sections with high inclination angles, insufficient weight on the drill bit, and environmental considerations. However, applications for long-distance wells need not be limited solely to the area of production, but can also be applied to the sector of transport by pipeline, in which long-distance wells connected in series can be constructed for the transport of gases and/or liquids.

Current technology of long-distance wells is based on a single well, with considerable problems in access to remote areas due to the long distance from one single well. On the other hand, current technology in deep water consists of installing a floating production unit in waters of lesser depth and the use of wells of wet design and underwater manifolds, combined with flexible lines of very high cost as well as long-distance wells. There are, however, financial and technical limitations on this distance.

There are also serious problems with flowing via flexible lines due to the low temperature of the water at the bottom of the sea where the flexible lines are located. Long flexible lines are subject to problems of high viscosity of the fluid, the depositing of paraffin, and the formation of hydrates, as a consequence of the low temperature and high pressure. Technologies which make long-distance operation possible can reduce the length of flexible lines and even do away with them altogether, passing the fluids produced to be discharged for preference inside the well and in heated areas.

US Patent Nos. 5,735,350, 6,158,531 and 6,263,987B1, the disclosure of which is hereby incorporated by reference, relate respectively to drilling and completion with the use of conventional casing and in one stage, with the actual drilling column being used as the casing for vertical and lateral wells for long-distance production. The focus of these patents is the simultaneous performance of the drilling and completion of a petroleum and gas well. No provision is made for the production of oil and gas without casing for the well.

The technology described is applied principally to wells drilled on the Continental shelf.

On the other hand, current drilling processes include the drilling of a principal well or principal direction, and other multilateral wells for the exploitation
5 of the field. This involves the completion of a number of drilled wells, activities which are both slow and burdensome.

US Patent Nos. 5,551,521 and 5,894,897, the disclosure of which is hereby incorporated by reference, relate to methods and equipment for cementing a drilling column in the location of the well in order to drill and
10 complete oil and gas wells simultaneously. The object of these publications is the cementing of the drilling column as a casing for the well.

However, the patent literature relating to vertical wells or drilling processes invariably involves the completion of the drilled wells or only the drilling of the petroleum and gas production well.

15 On the other hand, patents relating to multilateral wells likewise relate to the completion of the drilling work.

The transport of petroleum and gas produced in multilateral land-based wells is carried out in conventional pipelines, this being a process entirely within the public domain. The transport of petroleum and gas produced in underwater
20 multilateral wells is limited by the difficulties incurred by deposits of paraffin and the formation of gas hydrates on the pipe walls, brought about over long distances in deep water at low temperature. Technical proposals have been made for avoiding paraffination and the formation of hydrates, as well as the thermal insulation of the flexible pipes which transport the petroleum, but the
25 solutions proposed normally involve a greater or lesser increase in costs.

US Patent Nos. 4,660,606 and 4,556,343, the disclosure of which is hereby incorporated by reference, describe a method and an offshore installation intended to receive, store, and transfer crude petroleum from at least one well located on the seabed. These patents make provision for the use of pipes which
5 are suitable for the transport of oil between the production wellheads and the pipe which collects the oil from various different wells and conveys it to the installation forming the object of the patent. The pipes start from the seabed and, depending on the size of the production field and the scale of the installations to be used, may have to cover considerable distances over the
10 seabed until reaching the installations with which they are to be integrated.

US Patent Nos. 4,770,199 and 4,781,207 the disclosure of which is hereby incorporated by reference, relate respectively to a method for the transporting of heavy oils and a method for transporting viscous heavy oils, in which an emulsion of the oil in water containing an organic emulsifying
15 compound is transported and subsequently separated again into crude oil and water. These patents say nothing about the physical means by which the transport of the emulsion of oil in water is carried out, and still less about the chemical aspects involved.

US Patent RE28,978, the disclosure of which is hereby incorporated by
20 reference, describes an underwater system for the production and transport of fluid minerals, which includes a collection network for the product provided with production satellites in which the gas-oil-water ratio from each well is periodically tested and the flow rate automatically controlled, and the fluids of which are transported through individual pipes to the underwater product collection
25 stations, and then as far as the surface through rigid pipes amounting to half the mass of the seawater. In the event of excessive pressure arising in the pipe which transports the fluid from the seabed to the surface, this system makes provision for a section of the pipe to be an escape section, which would break,

and around which the fluid would be collected in an inverted funnel, so restricting losses of fluid to a minimum.

US Patent No. 5,154,741 the disclosure of which is hereby incorporated by reference, describes a system for the production and transport of oil and gas in deep water, including a wet "Christmas tree", a vertical two-phase oil and gas separator, a gas cooler, a vertical tubular scrubber, a motorized pump, and a platform on which a speed variator for the motorized pump is located, a pressure relief valve to provide simultaneous control on the gas pipe, the scrubber, the two-phase separator, and a programmable logic controller. The passage of the fluids between the production wellhead and the Christmas tree makes provision for the use of at least one pipe running on the seabed. The passage of the oil and gas on the basis of the system described in this patent as far as the production plant makes provision for equipment for artificial elevation, and is carried out via a separate oil pipe and gas pipe, running on the seabed and crossing the seawater mass as far as an offshore platform situated on the surface.

As can be seen, all the patents referred to make provision for at least one pipe extending over the seabed in half the fluid mass, for the transport of the fluids produced by the wells as far as a specific underwater installation, from which the fluids are conducted by at least one further pipe as far as the production installations located on the surface.

In addition to the difficulties encountered with the depositing of paraffin and the formation of gas hydrates on the inside walls of the pipes which run long distances in deep water at low temperature, there is also an increased risk of leaks of the fluids and the pollution of the surrounding environment through which the pipes run, which increase in proportion to the quantity and length of the pipes used in the transport of the fluids.

Another disadvantage of the processes and methods of the prior art is that they all require the use of various items of equipment and accessories for transporting the fluids from the underwater petroleum fields, in quantities which are proportional to the number of petroleum and gas wells in the production group: wellhead equipment, Christmas trees, manifolds, well production lines, risers, gas pipes, oil pipes, and separators, all of which incur increased costs for installation and maintenance.

Another aspect is that the current petroleum production systems in deep water necessarily involve the continuous use of production platforms, with the high costs which these incur. It is normally necessary to make use of a number of platforms, depending on the depth of the water in which the wells being drilled are located. The principal patents for underwater production of oil and gas are analyzed hereinafter.

US Patent No. 5,899,637, the disclosure of which is hereby incorporated by reference, describes offshore production and storage equipment for petroleum and the respective method of installation in which the oil is produced and stored in tanks fixed to the deck of a concrete raft which is towed and submerged by the use of seawater as ballast, and kept on the seabed close to the oil production site. The oil is removed from the submerged tanks by a tanker vessel by the introduction of seawater into the submerged tanks. This patent presupposes the use of at least one additional pipe for moving the oil from the production station or from the collecting point located on the surface to the submerged tanks, with all the disadvantages already known, deriving from this being conveyed at the low temperatures of the water at the bottom of the sea (paraffin deposits on the interior of the pipe and the formation of hydrates). In addition to this, additional costs are incurred by the equipment characteristically used in this method (concrete raft, tanks, additional production and water lines) and the respective associated services (tug, ballasting and submerging the raft

and tanks, the introduction of water into the submerged tanks, the installations, the control systems, and so on).

US Patent No. 5,330,293, the disclosure of which is hereby incorporated by reference, describes a system for the production and storage of petroleum, comprising the use of a large platform on tensioned legs in which a number of "risers" are used, which allow for freedom of vertical movement, and which therefore involve additional special structural requirements for floatability and arrangements to provide adequate support, restricting lateral movement but without the very high additional loads being applied to the platform. With the use of the "risers" this undoubtedly will incur substantially greater costs than those involved with the technique described and claimed in this present patent. US Patent Nos. 5,439,321, 4,913,238, and 4,556,340, the disclosure of which is hereby incorporated by reference, envisage hydrocarbon production systems which make use of floating structures, associated or not with tensioned-leg platforms, with the sheltered production deck being free to carry out vertical movements ("heave") close to the surface, and being equipped with wellhead equipment which is connected or not by flexible risers to underwater wells. In this way, in all the patents cited in this paragraph, the production from each underwater well is processed individually, always requiring production lines, wellhead equipment, and risers; essentially, all the normal individual items of equipment for each well, which incurs a multiplication of the costs for the production equipment. There are also disadvantages associated with conveying through different pipes at low temperatures through water on the seabed (depositing of paraffin on the inside of the pipes, formation of hydrates), which multiply at least proportionally as a function of the quantity and length of the pipes used, such disadvantages being minimized by the process according to the invention described hereinafter.

US Patent No. 4,653,960, the disclosure of which is hereby incorporated by reference, makes provision for a crude oil separator and an offshore submersible storage apparatus which can also form a stable platform, in that an offshore structure or vessel for the drilling and production of petroleum products
5 can be placed in position in a removable manner. This patent makes provision principally for the separation of crude oil and its storage, with the apparatus, being movable, also being capable of serving as a mode of transport for the products in the storage containers to another maritime installation for processing the petroleum produced.

10 US Patent No. 4,452,312, the disclosure of which is hereby incorporated by reference, describes a modular underwater oil production plant having at least one satellite unit, the product of which is conducted via a collector pipe to a central structure in which operational modules are grouped. Provision is made for the use of production heads and "templates", and the installation of the
15 production plant in excavations made on the seabed, with all the costs which the equipment and services associated with this will certainly incur.

US Patent No. 4,273,066, the disclosure of which is hereby incorporated by reference, envisages a method for the release of oil from an offshore well to the coast, comprising supply stretches for the oil from the well to a floating
20 storage vessel stationed close to the well, and the transfer of the oil by means of a flexible pipe from the floating storage vessel to a service petroleum vessel which runs between the coast and the floating storage vessel. This patent makes provision for at least two lines for the passage of the fluids, one between the well and the floating storage vessel and the other between the latter and the
25 service vessel, incurring the disadvantages of the formation of paraffin and hydrates in the submerged lines at low temperatures and high pressures, with the additional costs of the transport of the products via the petroleum vessel to the coast.

US Patent No. 4,152,088, the disclosure of which is hereby incorporated by reference, comprises offshore petroleum field production equipment with a production platform anchored to the seabed at the drilling site. It comprises a pivoted column connected by means of a universal Cardan coupling joint to a base anchored on the seabed, in connection with a floating gas burner located remotely for burning off the gas extracted from the oil. The production equipment items of the underwater wells are individual items, and the system makes provision for production lines and gas lines to the burner running over the seabed.

US Patent No. 4,762,180, the disclosure of which is hereby incorporated by reference, provides for a modular completion system close to the surface, which positions the production heads of the wells in a calm area beneath any significant wave activity, but within the operational range of divers for maintenance and inspection, in which each underwater well is provided with its own "riser", a tensioning buoy on the riser, and a production well tree mounted on top of the riser buoy. The fluids produced are passed from the well tree to the floating production platform by means of flexible risers suspended in a catenary curve of sufficient length as to allow the platform to be maneuvered so as to be positioned for drilling or workover of any of the various templates which it serves.

US Patent No. 4,211,281, the disclosure of which is hereby incorporated by reference, envisages a multiple-articulated well production system in deep water for the handling of fluids produced from a number of individual wells drilled in deep water in different parts of a field, and the conveying of the fluids from the production wells to a surface production platform by means of a central riser.

US Patent Nos. 5,255,744 and 5,341,884, the disclosure of which is hereby incorporated by reference, envisage an underwater production system and methods for the connection of pipes in a "manifold", and adjacent satellite wells in which the satellites are connected to the manifold via production pipes

which run at a distance between each satellite well and the manifold, supported on the seabed and with half the mass of seawater.

As can be seen, the petroleum production systems in deep water which currently exist make use of individual items of equipment and individual
5 production pipes for each well, associated with the manifolds or Christmas trees which collect the fluids produced from the various different wells and transfer them to additional lines which, in turn, travel via the production risers to the surface platforms equipped with petroleum production plant.

The different depths of the sea in which the wells concerned are located
10 also require that the load losses due to the flow in the production lines be kept to a minimum in order to optimize the production from the wells, impose the use of more than one production platform per production field, and so substantially increase the costs of production and maintenance of the equipment, as well as the other individual costs of the equipment per well and those of the production
15 pipes laid on the seabed, individual wellheads, manifolds, and "Christmas trees".

Another disadvantage of these systems is associated with the exposure of the large number of different items of equipment of the wellheads, Christmas trees, manifolds, pipes, lines, collector stations, satellites, risers, and the fluids which circulate within them, to the adverse conditions of high pressure and low
20 temperature present during the movement, consequently resulting in the depositing of paraffin inside the pipes and the formation of hydrates, which in the future will require cleaning operations, maintenance, or even the repositioning of the equipment and pipes at extra cost which will undoubtedly be substantial.

In addition, in order for the pipes to be grouped together for production,
25 individual completion services will be required, which incur the costs of the immobilization and movement of the platforms, incurring heavy operational, service, and maintenance costs, in addition to the other well operations inherent

in completion which precede the commissioning of these pipes, and the time taken (down-time) inherent in the other actions involved in completion services.

Accordingly, all the patent literature relating to the drilling of petroleum and gas wells stipulates that these must invariably be provided with casing, up to
5 the actual drill pipe itself, such as in US Patent No. 6,263,987B1. When applied in deep water, the processes described become extremely expensive and slow.

Accordingly, despite the developments which pertain, the prior art still requires drilling processes for oil and gas wells which involve multilateral long-distance wells in deep water without any type of completion of the drilled well,
10 and with the use of one single surface platform for all the wells in production, such processes being described and claimed in the present patent.

SUMMARY OF THE INVENTION

In a simplified manner, the method for the construction of an arrangement of long-distance wells for the production, transport, and exploitation of mineral
15 deposits, the arrangement of the wells thus constructed, and a method for the construction of a pipe for the transport and storage of fluids according to the invention comprises the initial drilling of a medium-distance well. At least one other multilateral medium-distance well is drilled in the same direction as the first, and in one or more directions into the reservoir which is to be taken into
20 production, with the aim of their ends meeting or coming close, there being no type of completion and casing for the multilateral drilled well(s). The production from the wells is effected by pressure differential, the fluid flowing from the well of greater pressure into the well of lesser pressure.

The invention also comprises the drilling of wells in series to be used as
25 transport pipes. These wells are connected hydraulically, in such a way that the

resultant distance is proportional to the number of wells drilled; i.e. infinite number of wells, infinite distance.

In addition, the present invention makes provision for the connection in series of a principal well and at least one multilateral well, in order to supplement
5 the resultant distance and to drain distant areas of the reservoir.

The invention also makes provision for the connection of a series of two or more wells in order to increase the resultant distance and to transport gases and/or liquids between distant areas.

The invention likewise provides for arrangements of wells drilled at such
10 long distances as may be necessary, using the technology of medium-distance wells.

The invention likewise provides for arrangements of wells drilled at long distances in which only the main well needs to be connected to the production unit.

15 The invention likewise provides for arrangements of wells forming a network for draining reservoirs of mineral layers.

The invention likewise provides for arrangements of long-distance wells which does away with the need to break the reservoir in order to obtain the fluids produced.

20 The invention additionally provides for the possibility of producing fluids via long-distance wells doing away with the use of individual items of equipment for each well, with great savings in costs and environmental protection.

The invention likewise provides for a method for the construction of pipes in series and/or in parallel, forming a network for the transport and storage of
25 fluids produced from medium-distance wells and connected hydraulically.

The invention likewise provides for a production method for mineral layers in which the flowing of the fluid produced is effected from a well of greater pressure to a well of lesser pressure.

5 The invention likewise provides for a network of wells for a mineral layer in which only the principal well needs to be completed.

As can be easily verified on the basis of the considerations set forth in this text, the disadvantages determined for the prior art in the drilling of long-distance multilateral wells, such as high running costs of the multiplicity of equipment, as well as environmental corrosion, are greatly reduced or even eliminated with the method proposed by the present invention.

According to the invention, therefore, the method comprises the drilling of an initial well and a number of other multilateral directional wells, following the preliminary indications from geological studies, which allows for the formation of a network of underground channels with the aim of obtaining the best possible use of the fluids present in the reservoir.

According to a preferred embodiment of the invention, the initial well directional well.

According to another embodiment, the initial well a multidirectional well.

According to another embodiment, the initial well is a vertical well.

20 The flow from the reservoir is associated with the collection in production of the multilateral wells which are drilled. The production from the wells of the network is incurred by the difference in pressure, causing the flow of fluids from the wells with greater pressure in the direction of the well with lesser pressure. The flow of the fluids is interrupted by equipment installed on this lower pressure well, to a production plant located on a platform on the surface of the sea.

Depending on the nature of the fluid, the equipment used may be a pump or a compressor.

The practice of the invention dispenses with the operations of completion and casing of each multilateral well, it being only necessary to install casing and complete the well of lesser pressure which is interlinked with the production platform.

According to the concept of the invention, the operations of specific drilling, the connection of the wells, and the equipment used in the operations are those commonly used in the state of the art, and do not constitute the object of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be further described, by way of non-limitative example only, with reference to the accompanying schematic drawings, in which:-

FIGURE 1 shows a view of an arrangement according to the invention, with a multilateral well 2 and two drilling sections in opposite directions and of medium distance 5 and 6, the well 2 being connected hydraulically to the medium-distance well 1 by means of the drilling section 7.

FIGURE 2 shows a diagram of the exploitation of a field in deep water, using the concept according to the invention.

FIGURE 3 shows a view of an arrangement according to the invention, in which two wells of medium distance 1 and 2 are hydraulically connected to each other and to the operational units 15 and 16.

FIGURE 4 shows a view of an arrangement according to the invention for another type of construction of a pipe across wells in series, in which four wells

1, 2, 2' and 2" are hydraulically connected to each other and to the operational units 15 and 16.

FIGURE 5 shows a view from above of the prior art with the conventional choice of construction of a pipe 18 cutting through a forest 19 and a river 20.

5 FIGURE 6 appended hereto shows a view from above of the invention with the method of construction proposed, of four wells in series 1, 2, 2' and 2" hydraulically connected, linking the production area 21 to the terminal 22.

FIGURE 7 appended hereto shows an example of the drainage network for fluids from a layer.

10 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

According to the usage of the invention, the term "fluid" signifies any material endowed with the capacity to flow, in the gaseous, liquid, or solid state, alone or in a mixture in any proportion. The fluid may accordingly be petroleum, gas, or even a mineral or sand.

15 "Formation" is a production formation, such as a formation producing petroleum or gas.

"Reservoir" is the rock of the production formation, located in the ground or sub-soil, which contains a reserve, layer, or accumulation of minerals, such as a reservoir of hydrocarbons, petroleum, and/or gas.

20 FIGURE 1 shows a side view of an arrangement in accordance with the invention, in which the multilateral well 2, with two drilling sections in opposite directions and of medium distance 5 and 6, are connected hydraulically to the medium-distance well 1 by means of the drilling section 7.

According to one embodiment of the invention, the offshore reservoir 3 of fluids is initially penetrated by the well 1. The multilateral well 2 is then drilled, coming close to or connecting with the end of the drilling section 5 of the well 2 at the end of the drilling section 7 of the well 1. This accordingly forms a long-
5 distance well, connecting hydraulically the end 6 of the well 2 to the end 7 of the well 1 and to the production unit 8. The resultant long-distance well will allow for flow from the reservoir in deep and extremely deep water 10 from a platform in shallower waters 9. The well 1 can even be of dry completion.

Alternatively, according to another embodiment, a connection is
10 established between the well 1 and the production platform unit 8 by means of a rigid production pipe arranged inside the riser or flexible line 11 of short length. The well 1 will be the production well. The head 4 of the well 2 can be simply closed off. This head 4 may possibly be used in cleaning or fishing operations, serving as a viewing aperture for inspection.

15 Accordingly, the initial well 1 may have its length increased by about three times, which can be determined by considering Figures 1 and 2. In these figures the medium-distance well 2 is drilled with two drilling sections in opposite directions 5 and 6, and is connected hydraulically to the initial well 1 of medium distance, the drilling section 7 of which is equivalent to each of the drilling
20 sections 5 and 6 of the well 2. The final distance obtained is therefore the result of the sum of the distances of the three drilling sections 5, 6, and 7, corresponding to a total length of approximately three times the distance of each section of medium-distance drilling.

It can be easily understood by persons skilled in the art that it is possible,
25 within the concept of the invention, to increase the distance of the well by more than three times by drilling one or more wells in the series 2, 2', 2'', 2n, which will also be connected hydraulically to the initial well 1, in such a way as to increase the total distance as desired. Only the initial well 1 needs to be

interlinked with the production unit 8. In this case, the other wells 2, 2', 2'', ... 2n will have the heads 4, 4', 4'', ... 4n closed off. This will allow for the sequence of the wells to reach very distant areas of the reservoir 3.

FIGURE 2 shows the exploitation diagram of a field in deep water, using the concept of the invention, and, in a horizontal projection, an arrangement of nine multilateral wells, 1 being the initial well and 2, 2A, 2B, 2C, ... 2G being multilateral wells corresponding to the wellheads 4, 4A, 4B, 4C, ... 4G of medium length, intended to drain the fluids produced from the field to a production unit 8. The multilateral wells 2, 2A, 2B, 2C, ... 2G may have two drilling sections in opposite directions 5 and 6, three drilling sections of oblique orientation 5, 12, and 13, or three drilling sections, two being in opposite directions 5 and 6 and one drilling section 14 of orthogonal orientation to the other two, depending on the area of the reservoir which it is intended to enclose with the drainage. An initial multilateral well 1 of medium distance and of multiple drilling sections 7, 7A, 7B, 7C, ... 7G, which connect hydraulically to the drilling sections 5, 5A, 5B, 5C, ... 5G of the multilateral wells 2, 2A, 2B, 2C, ... 2G, conducting the fluids drained from the reservoir 3 to the production unit 8 on the surface.

Still within the concept of the invention, the construction of a pipe for the transport and storage of fluids is the object of the following Figures:

FIGURE 3 shows a side view in which two medium-distance wells 1 and 2 are hydraulically connected. These wells interlink the operational units 15 and 16, and form a conventional pipe for the transport of liquids and/or gases. The underground reservoir 3 is initially penetrated by the well 1. The well 2 then penetrates it, connecting to the end of the drilling section 5 of the well 2 at the end of the drilling section 7 of the well 1. A long-distance well is accordingly formed, hydraulically connecting the well 2 to the well 1 and the production unit 8.

Alternatively, the well 2 can also be drilled in the opposite direction. The head 4 of the well 2 can be simply closed off. The head 4 of well 2 can possibly be used as a viewing opening for inspection operations or for cleaning. The pumping or compression equipment 17 promotes the transport of the fluids from the unit 15 to the unit 16. The final compression of the pipe will depend on the total number of wells drilled in series.

FIGURE 4 shows a side view of an alternative construction of a pipe across the wells in series, in which four wells 1, 2, 2' and 2'' are hydraulically connected to one another and to the operational units 15 and 16.

FIGURE 5 shows the conventional option for the construction of a pipe 18 cutting through forest 19 and river 20, in which the pipe 18 linking the production area 21 with the terminal 22 is laid on the forest floor 19 or in an excavation 23 initially open. To cross the river 20, the pipe 18 will have to pass beneath the bed of the river 20, the excavation 23 of this stretch being carried out with the use of specific equipment (boring machine).

FIGURE 6 illustrates the inventive proposal of the construction of four wells in series, 1, 2, 2' and 2'', connected hydraulically and linking the production area 21 to the terminal 22. The wells 1, 2, 2' and 2'' are drilled with two drilling sections in opposite directions, in such a way that the drilling section of one well interlinks with the drilling section of the following well. The first well 1 will have a drilling section connected to the production area 21. In the same way, the last well 2'' will have a drilling section which will connect to the terminal 22. The proposed method dispenses with the laying of any pipes or the need for specific equipment not provided for in the drilling operation.

FIGURE 7 shows a possible version of a drainage network for a reservoir with a fluid-producing layer. The network is formed by the arrangement of multilateral wells drilled in series (1, 2, 2', 2'', ..., 2n, 2A, 2A', 2A'', ...2An) and/or

in parallel (40, 40', 40", ..., 40n, 50, 50', 50", ... 50n in relation to 2, 2', 2", ... 2n, 2A, 2A', 2A",... 2An) and in an arrangement such as will allow for the optimization of the drainage from the whole production area of the fluids in the mineral layer, it being possible to bring about the intersection of the wells with one another (30, 30A', 30A", ... 30n in relation to 40, 40', 40", ..., 40n and 50, 50', 50", ... 50n). The differences in the pressures between the different wells will determine the flow of the fluids being in the direction from the wells of greater pressure (2, 2', 2", ..., 2n, 30, 30', 30", ... 30n) towards the well of lower pressure 1, which becomes the production well for the layer. The other wells will have their heads sealed.

According to the concept of the invention, therefore, and as can be seen from the arrangements illustrated in FIGURES 1 to 7 appended hereto, a first reduction in costs is achieved with the elimination of the operation of fracturing the geological formation. In effect, the present concept replaces the traditional methods of fracturing the formation by the arrangement of a network of channels obtained with the medium-range wells drilled and hydraulically connected to one another.

As a further advantage, the elimination of the operation of fracturing the formation also makes it possible to gain time in taking into operation the production wells which drain the formation, so shortening the return time on the investments assigned.

Another advantage of the method is the reduction of costs achieved by both the elimination of the completion of the multilateral wells and of the use of casing and cementing of the walls of the respective wells.

By analogy, the elimination of the operation of completion of the wells will achieve an extra gain in the time taken for the commissioning of the wells drilled, so accelerating the financial return on the project.

Another advantage of a technical nature is additionally achieved by the removal of the obstacle presented by the casing of the wells against the flow of the fluids, making it possible for greater yield to be obtained from the production wells.

5 Equally advantageous is the reduction achieved in the investment costs, with the reduction in production equipment to the minimum necessary, represented by one single pump or compressor, by the equipment for the single wellhead, the Christmas tree, the production line, the riser, and other single items of production equipment.

10 Operationally, another economic advantage can likewise be achieved in the form of lower costs for maintenance services and intervention on the well, once the quantity of production equipment has been drastically reduced to the minimum necessary for production by means of one single well.

15 As an immediate consequence, another operational advantage is achieved with a reduction of the probable down-time for the well.

A second advantage of a technical nature is achieved by a reduction in the costs of handling the well production equipment, reduced to the minimum necessary.

20 In addition, a substantial saving in operational terms is also obtained thanks to the use of one single production platform for the processing of the fluids produced from the formation.

25 This saving becomes more evident if it is noted that the proposed process will allow for the platform to be positioned in substantially shallower water (see Figure 1), so requiring less robust equipment, which is capable of operating under less severe conditions, as well as much lower costs for planning, immobilization, transport, operation, and handling.

A third technical advantage is to be gained in respect of the increase in productivity with the flow of fluids leaving the multilateral wells to the principal well in underground channels, which are therefore protected against the low temperatures encountered at great depths in the sea, and so minimizing the problems incurred by the depositing of paraffin and the formation of hydrates,
5 with positive effects on flow rates.

From the point of view of the environment, one of the advantages which the process provides is a reduction in the risk of leaks and environmental pollution between the main well located on the sea bed and the production
10 platform on the surface, incurring a reduction in the number of pipes and submerged production equipment to the minimum necessary to service one single well.

From the consideration of the environment, too, if the due proportions are maintained, it will be observed that difficulties analogous to those which pertain
15 at the laying of the pipes and the installation of other underwater production equipment will also arise when the same type of service is carried out in other severe and hostile environments, such as swamps, jungles, dense forests, or inhospitable deserts.

In the case of dense tropical forest, lakes, swamps, or rivers, the method
20 according to the invention leads to additional gains both in terms of the environment and financially; namely, these are the avoidance of clearance or crossing of hostile environments, with possibly damaging effects on the flora, fauna, soil, and, in the final analysis, on all the other elements in the particular ecosystems pertaining to them, as well as the costs of obtaining the
25 environmental licenses from the regulatory authorities, or the obligation to undertake relocation of persons, animals, and materials which are potentially capable of being removed (timber extracted, courses and bodies of water dammed or diverted, specimens of animals, birds, and plants to be preserved,

movement of earth to be introduced or removed, and all the services associated with or inherent thereto).

Finally, advantages of a socio-economic-demographic order can also be obtained by the process according to the invention if, by its use, the crossing of pipes and installation of other equipment can be avoided in densely populated areas such as urban centers, coastal areas, tourist areas, or leisure and vacation areas, so reducing the impacts resulting from expropriations, population relocations, urban works, demolitions, traffic hold-ups involving both vehicles and pedestrians, and the exposure of the public to the potential risks of gases and vapors.

Accordingly, the present invention allows for long distances to be achieved without the need for special probes and equipment necessary for the drilling of very long-distance wells, and so only requiring equipment readily available on the market. As a consequence, the invention will have a great impact on production in deep and very deep water, since petroleum and gas wells will reach reservoirs located in very deep water from a platform which is installed in very shallow water.

The invention will also have a great impact on pipeline transport in sensitive areas as well as in densely populated areas, forests, lakes, swamps, rivers, and coastline regions close to urban or tourist centers, without forgetting the reduction in the environmental impact and the minimization of the risk of leaks which would certainly pertain.